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(56) Documents cited

GB 2169038 A

GB 2078309 A

GB 1534124 A

GB 0938189 A

GB 0865545 A

US 4391565 A

US 4314793 A

US 4194869 A

(58) Field of search

UK CL (Edition L) F1V VCJ VCL VCQ

INT CL<sup>5</sup> F01D

(54) **Mounting arrangements for turbine nozzles**

(57) A turbine nozzle attachment comprises a radial and tangential load carrying hook 22 and a radial load carrying land 24. The hook fits onto a stud 28 in a stationary nozzle support. A plurality of nozzle segments are joined circumferentially to form an annular turbine nozzle. Each nozzle segment further includes a circumferentially extending support member 26 on an opposite circumferential end of the segment to the land 24. The support member 26 of one segment rests on the land 24 of an adjacent segment. The turbine nozzle mounting arrangement eliminates tangential stiffness, as compared to prior bolted designs, thus minimizing the stresses induced in the airfoil trailing edge due to thermal distortion of the nozzle mount.

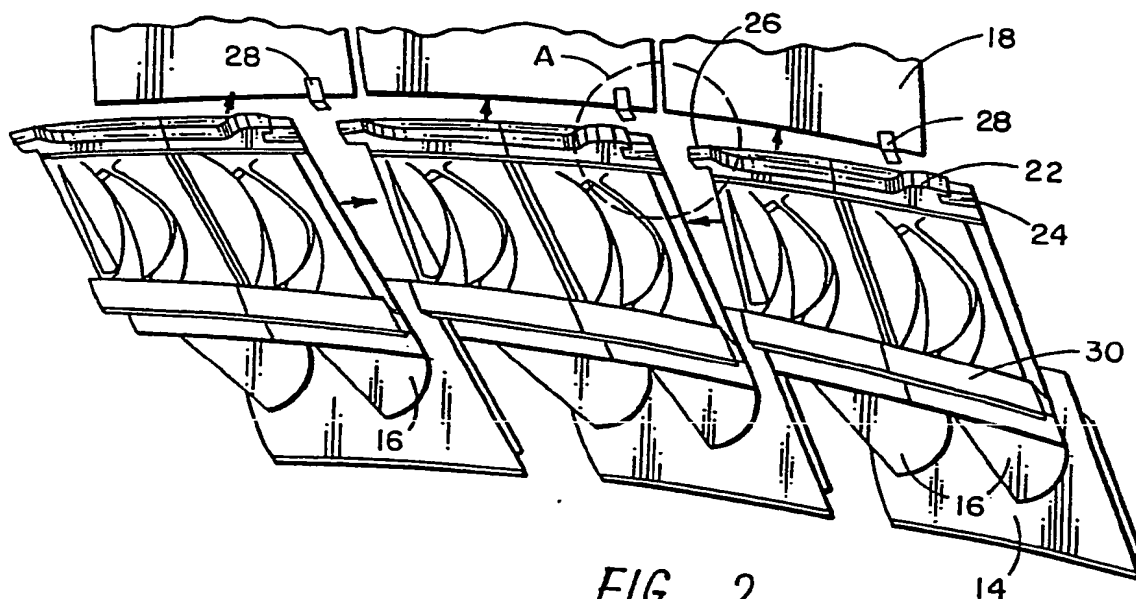


FIG. 2

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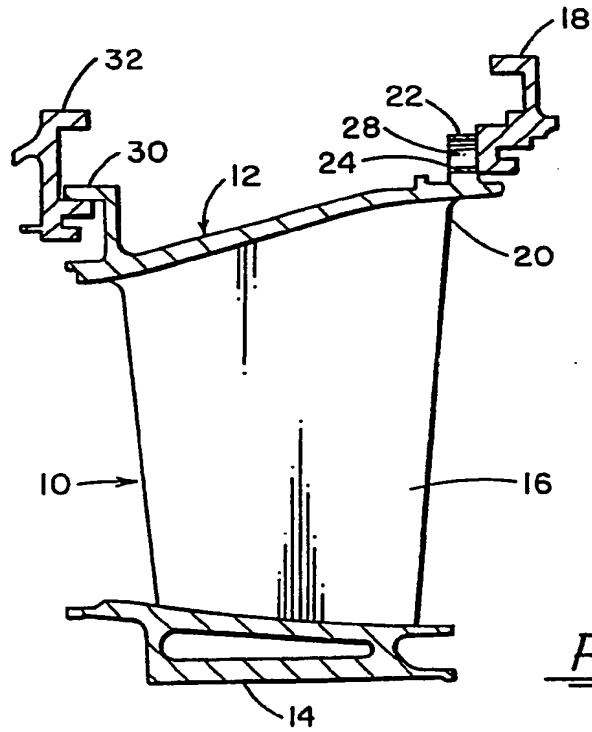


FIG. 1

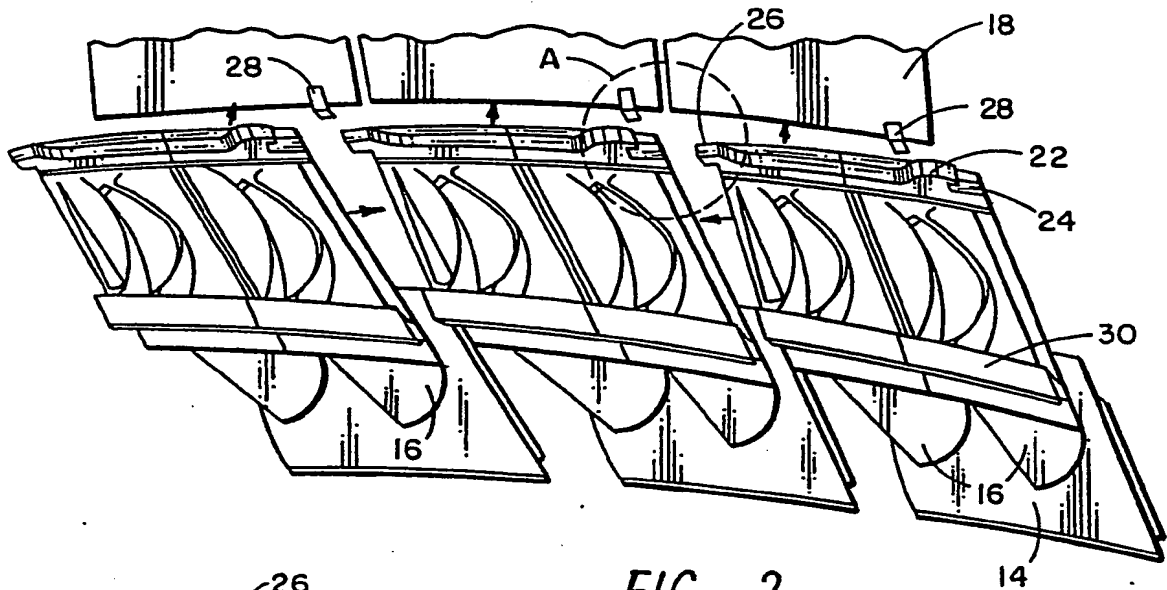


FIG. 2

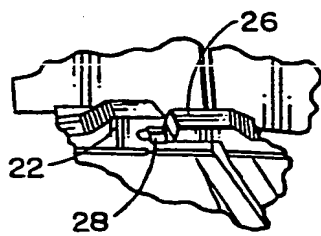


FIG. 3

## MOUNTING ARRANGEMENTS FOR TURBINE NOZZLES

The present invention relates to gas turbine engines and, more particularly, to mounting arrangements for turbine nozzles.

5 Turbine nozzles within a gas turbine engine provide the function of directing and/or re-directing hot gas flow from a turbine engine combustor into a more efficient direction for impinging on and effecting rotation of turbine rotor stages. A nozzle  
10 comprises a plurality of radially extending airfoils arranged circumferentially about an engine axis, the airfoils being supported by radially inner and outer circumferential bands. Either the inner or outer band may include some form of flange for coupling the  
15 nozzle to a stationary engine mounting structure. In general, a plurality of turbine nozzles is interleaved with a plurality of turbine rotor stages. At least some of the nozzles are supported only at their radially outer band in essentially a cantilever type  
20 arrangement since their radially inner band extends adjacent a rotating engine structure to which the turbine rotor stages are attached. The directing process performed by the nozzles also accelerates gas flow resulting in a static pressure reduction between

inlet and outlet planes and high pressure loading of the nozzles. Additionally, the nozzles experience high thermal gradients from the hot combustion gases and the coolant air at the radial mounting surfaces.

5        In common mounting systems, the turbine nozzle may be attached by bolts or a combination of bolts and some form of clamping arrangement to an engine support structure. In some stages, such as the first stage  
10        nozzle, the nozzle is attached to the engine stationary structure via a radially inner mount or flange structure coupled to the inner band. The radially outer band is not mechanically retained but is supported against axial forces by a circumferential engine flange. In other stages, such as stage 2 of an  
15        engine, the nozzle may be attached at its radially outer band but be free at its radially inner band.

      In either design, the use of bolts and clamps at circumferential locations about a nozzle band act as a restriction to the band, which band is hotter than  
20        the structure to which it is attached, causing radial bowing of the outer band of the nozzle and stressing of the airfoils attached to the band. Such stressing of the airfoils may lead to formation of cracks in the airfoil trailing edge.

25        One aspect of the present invention is specified in the claims to which attention is invited.

      A preferred embodiment of the present invention overcomes the above mentioned disadvantages as well  
30        as others of bolted or clamped turbine nozzles by eliminating such bolting and clamping while providing a positive attachment between a turbine nozzle and an adjacent engine support structure. In one form, the inventive turbine nozzle  
35        attachment comprises a nozzle mount having a

radial and tangential load carrying hook and a radial load carrying land. The nozzle hook fits onto a stud in a stationary nozzle support, the stud being adapted for carrying the tangential and radial load from a respective one of a plurality of nozzle segments. The plurality of nozzle segments are joined circumferentially to form an annular turbine nozzle. Each nozzle segment includes a nozzle mount for coupling to a corresponding stud. Each nozzle segment further includes the radial land on one circumferential end of the mount and a circumferentially extending support member on an opposite circumferential end of the segment. The radial support member of one segment rests on the land of an adjacent segment. The gas loads on the nozzle segments cause each segment to load up on the support studs in the tangential and radial directions. The support members on each opposite segment end load radially downward on a land of an adjacent segment. The axial load is taken by the axially aft surfaces of the support member and hook against the stationary, radially outer nozzle support. One advantage of this turbine nozzle mounting arrangement is the elimination of tangential stiffness, as compared to the prior bolted design, thus minimizing the stresses induced in the airfoil trailing edge due to thermal distortion of the nozzle mount. Another advantage is a lighter weight design having fewer parts and easier assembly and disassembly.

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For a better understanding of the present invention, reference may be had to the following

detailed description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a tangential view of a turbine nozzle segment coupled within a turbine in accordance with the present invention;

FIG. 2 is a partial exploded view, taken generally axially, of the turbine mounting arrangement of FIG. 1; and

FIG. 3 is an enlarged view of area A of FIG. 2.

Referring to the figures generally and in particular to FIGS. 1 and 2, there is shown a tangential view of a turbine nozzle segment 10 within a gas turbine engine and a generally radial view of a turbine nozzle, respectively. The nozzle segments 10 are arranged in a circumferentially abutting relationship about the turbine engine to form a generally continuous nozzle. Each segment 10 includes a radially outer mount or band 12 and a radially inner band 14. In the illustrative embodiment, each segment 10 includes a pair of airfoils 16 extending between the inner and outer bands. In an assembled configuration, the inner bands 14 abut the adjacent bands 14 of adjacent segments to form a generally continuous radially inner band which acts as an inner boundary of a gas flowpath for gases flowing through the turbine engine. The bands 14 may include slots in their circumferential ends for receiving metal leaf seals (not shown) to reduce gas leakage between adjacent segments.

The illustrative nozzle segments 10 are of a type which are mounted at their radially outer bands 12 to

a stationary support, such as support 18, which is attached to the structural frame (not shown) of the turbine engine. In prior art systems, the outer band 12 is typically bolted to the support 18. The temperature of support 18 is sufficiently less than that of band 12 to result in differential thermal expansion which tends to warp band 12 and stress the attached airfoils 16 to a point such that cracking of the airfoil trailing edges 20 of the trailing vane 16 occurs. In order to alleviate this problem, the bolted connection is eliminated and the radially outer band 12 is formed with a hook 22 and a radial load carrying land 24 adjacent one circumferential end. A radially load carrying, circumferentially, extending member 26 is formed on an opposite circumferential end of the band 12 for mating with land 24 when the nozzle segments 10 are in an assembled configuration. The support 18, which may comprise a plurality of circumferential segments, incorporates a plurality of studs 28 each aligned with a respective one of the hooks 22.

Referring to FIG. 3, which is an enlarged view of the area A of FIG. 2, it can be seen that the hook 22 captures the stud 28 between itself and the land 24. The land 24 extends circumferentially beyond the hook 22 leaving space for receiving the extending support member 26 from an adjacent segment 10. The stud 28 carries the tangential and radial load from the nozzle segment 10. The support member 26 loads radially downward on the land 24 of an adjacent nozzle to prevent rotating about the stud 28 in a plane normal to the axis of the engine. Referring again to FIG. 1, the rotation of the segment 10 axially about stud 28

is prevented by an axially formed flange 30 which engages a forward stationary support member 32 coupled to the engine frame.

5 While the invention is illustrated in what is presently considered to be a best mode, various  
modifications will become apparent to those skilled in  
the art, including modifications to adapt the  
invention to other engine designs. For example,  
10 although the hook 22 is shown extending radially above the band 12 with a circumferential opening, some  
applications may require lowering of the hook into the  
plane of the band or forming the band with a slot to  
receive the stud 28 rather than using the hook 22.  
15 Further, it may be desirable to use a tongue and  
groove arrangement to replace the land 24 and support  
member 26.



CLAIMS

1. A turbine nozzle for coupling to a nozzle support member, the support member having a plurality of axially extending studs, the nozzle comprising:

5 a plurality of nozzle segments arranged in a circumferentially abutting relationship for forming a generally continuous nozzle; and

10 a first band attached to each of said nozzle segments, said first band including a hook for engaging a respective one of the studs for supporting said segments against tangential and radial loads.

2. The turbine nozzle of claim 1 wherein said hook is positioned adjacent a first circumferential end of said band and including:

15 a land extending circumferentially at said first end of said band; and

20 a support member extending from a second circumferential end of said band, said support member on each band of said segments overlaying a respective land on a band of an adjacent one of said segments and being supported thereby against radial rotation of said nozzle segment.

3. The turbine nozzle of claim 2 and including a flange positioned adjacent an axially forward edge of said band and extending circumferentially of each of said nozzle segments, and further including a  
5 second support member coupled to the engine for engaging said second flange for inhibiting axial rotation of said nozzle segment.

4. The turbine nozzle of claim 3 wherein said first band is coupled to a radially outer end of said  
10 nozzle segment, and further including a radially inner band coupled to said nozzle segment and arranged to define a radially inner gas flowpath boundary when said segments are in an assembled configuration.

5. The turbine nozzle of claim 4 wherein said  
15 first band of each of said segments extends circumferentially and axially for forming a continuous closed surface defining an outer gas flowpath boundary when said segments are in an assembled configuration.

6. The turbine nozzle of claim 2 wherein said  
20 hook extends above said flange and opens in a circumferential direction.

7. A turbine nozzle substantially as hereinbefore described with reference to the accompanying drawings.

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**Patents Act 1977**  
**Examiner's report to the Comptroller under**  
**Section 17 (The Search Report)**

**Application number**  
 GB 9220306.6

<b>Relevant Technical fields</b>		<b>Search Examiner</b>
(i) UK Cl (Edition L ) F1V (VCJ, VCL, VCQ)		C B VOSPER
(ii) Int Cl (Edition 5 ) F01D		
<b>Databases (see over)</b>		<b>Date of Search</b>
(i) UK Patent Office		20 JANUARY 1993
(ii)		

Documents considered relevant following a search in respect of claims 1 TO 7

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X Y	GB 2169038 A (UNITED) see Figure 2 and note stud 158 engaged by hook 98	1 2
X Y	GB 2078309 A (ROLLS) see Figures 2 and 3 and note stud 33 engaged by hook- like surfaces defined by slot 32	1 2
X Y	GB 1534124 (GENERAL) see Figures 3 and 4 and note studs 126 and hook- like surfaces defined by slots 124	1 2
Y	GB 938189 (RUSTON) see Figure 2 and note overlapping flanges defining support member and land	2
X Y	GB 865545 (NAPIER) see drawings and note U-shaped slot in Figure 2 which appears in Figure 1 to engage a stud like member to resist radial and tangential loads	1 2
X Y	US 4391565 (ROLLS-) see Figures 2 and 3 and column 2 lines 37 to 49. Note stud 33 engaged by hook- like surfaces defined by slot 32	1 2

Category	Identity of document and relevant passages	Relevance to claim(s)

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Patents Act 1977  
 Examiner's report to the Comptroller under  
 Section 17 (The Search Report)

Application number  
 GB 9220306.6

Relevant Technical fields

(i) UK CI (Edition ) Contd. from page 1

(ii) Int CI (Edition )

Search Examiner

C B VOSPER

Databases (see over)

(i) UK Patent Office

(ii)

Date of Search

20 JANUARY 1993

Documents considered relevant following a search in respect of claims

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X Y	US 4314793 (UNITED) see Figure 2 and note stud 38 engaging hook-line surfaces defined by slot 40	1 2
X Y	US 4194869 (UNITED) see Figures 1 and 4 and note stud 54 and hook-like surfaces defined by means 28	1 2

Category	Identity of document and relevant passages	Relevant to claim(s).

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